

The Origin of the Jurassic Quiet Zone - New Insights from Hawaiian Jurassic Magnetic Anomalies

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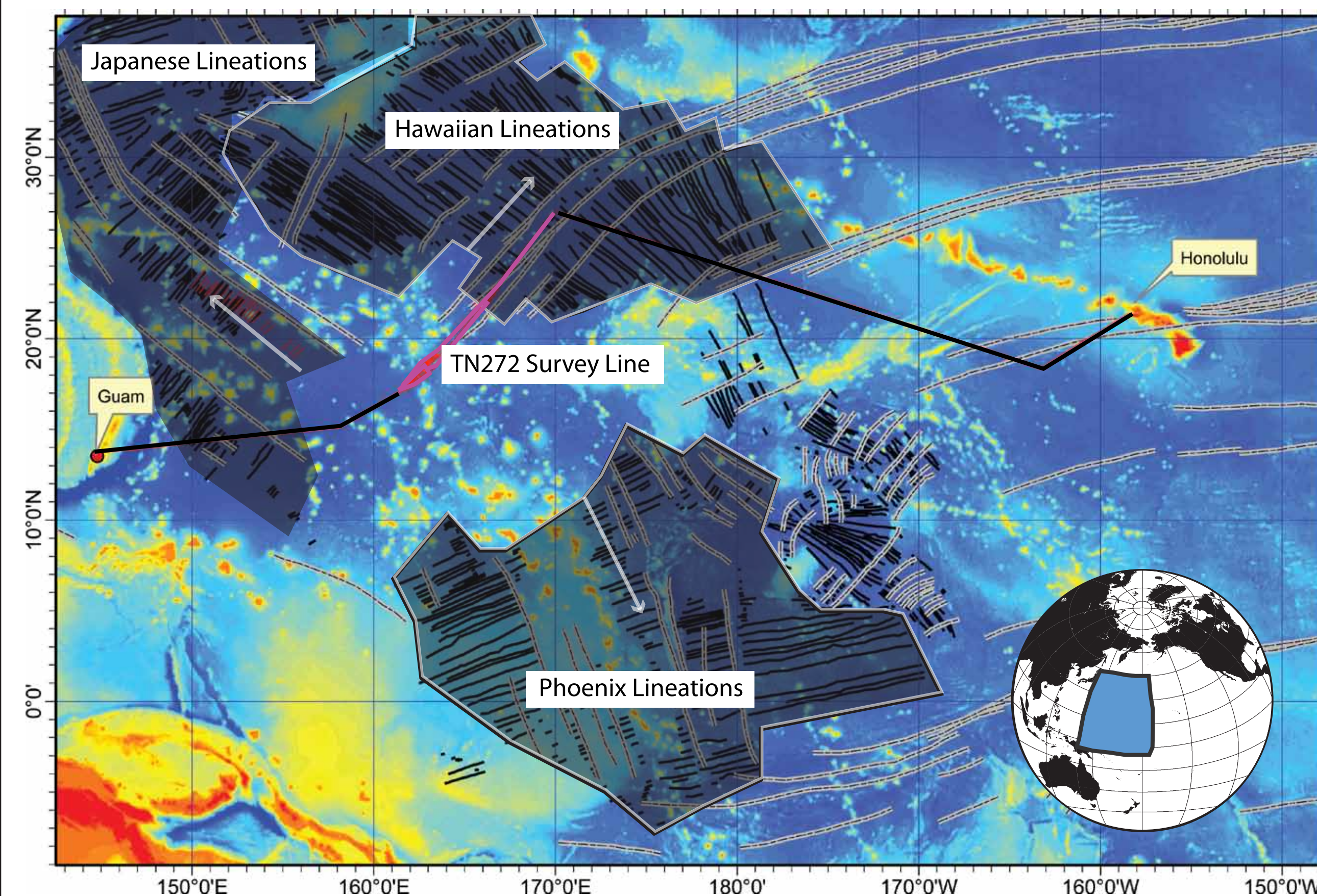
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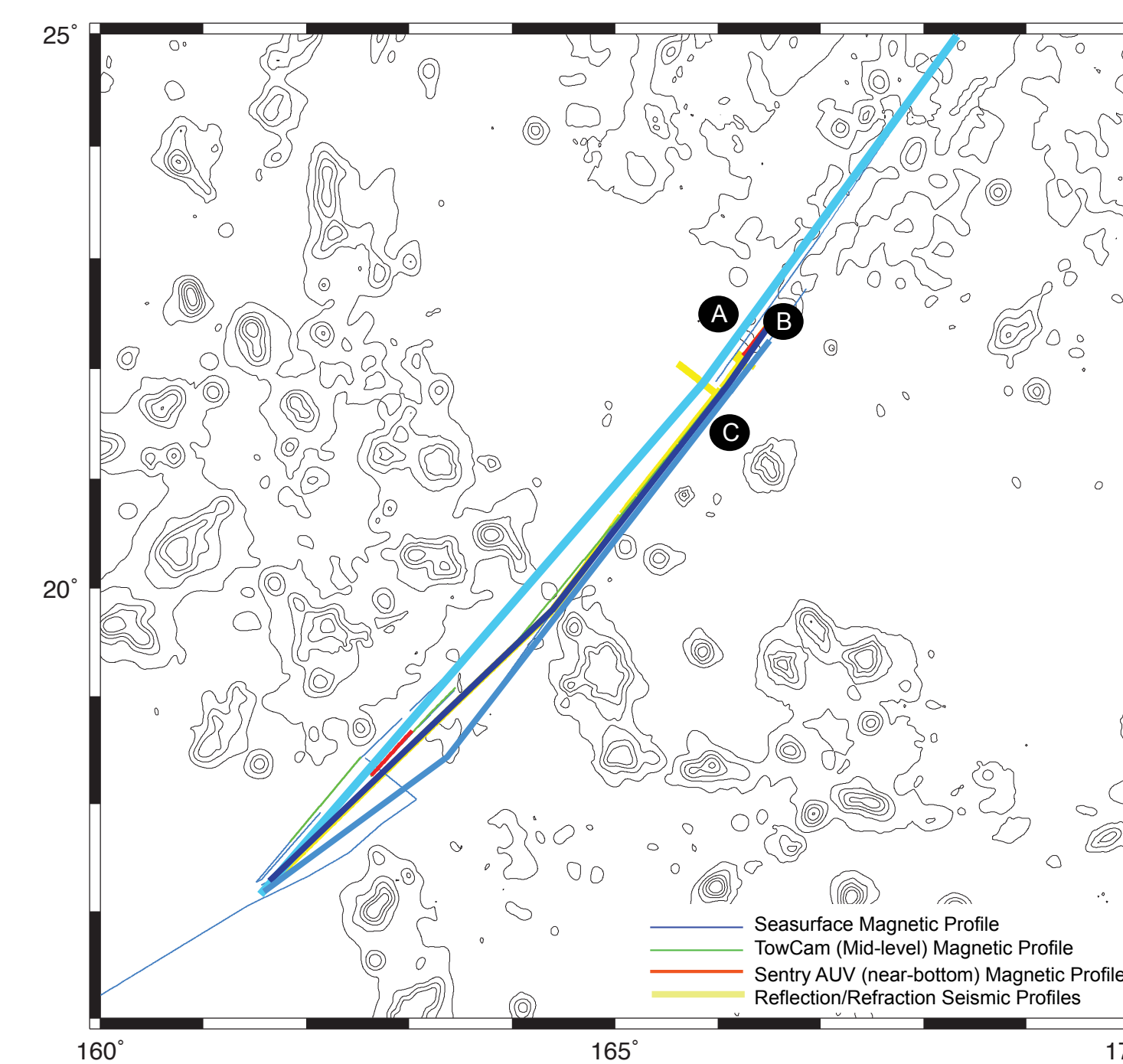


Background

Marine magnetic anomalies recorded in oceanic crust, have played a central role in documenting Earth's magnetic field history as compiled in the geomagnetic polarity timescale (GPTS). The oldest part of the marine record is the Jurassic Quiet Zone (JQZ) (preM29 chrons) which is known to be a period when field intensity was low, while reversal rate was high. The origin and character of the JQZ has been the subject of marine magnetic studies over past 20 years in the western Pacific where the oldest and arguably best preserved Jurassic magnetic anomalies create three Jurassic lineation sets (Japanese, Hawaiian, and Phoenix). The map below shows the three magnetic lineations sets converging on the Pacific Jurassic Quiet Zone region. The black and purple lines indicate the transit and survey lines respectively of the 2011 Hawaiian Near Bottom Magnetic Survey (Cruise TN-272).

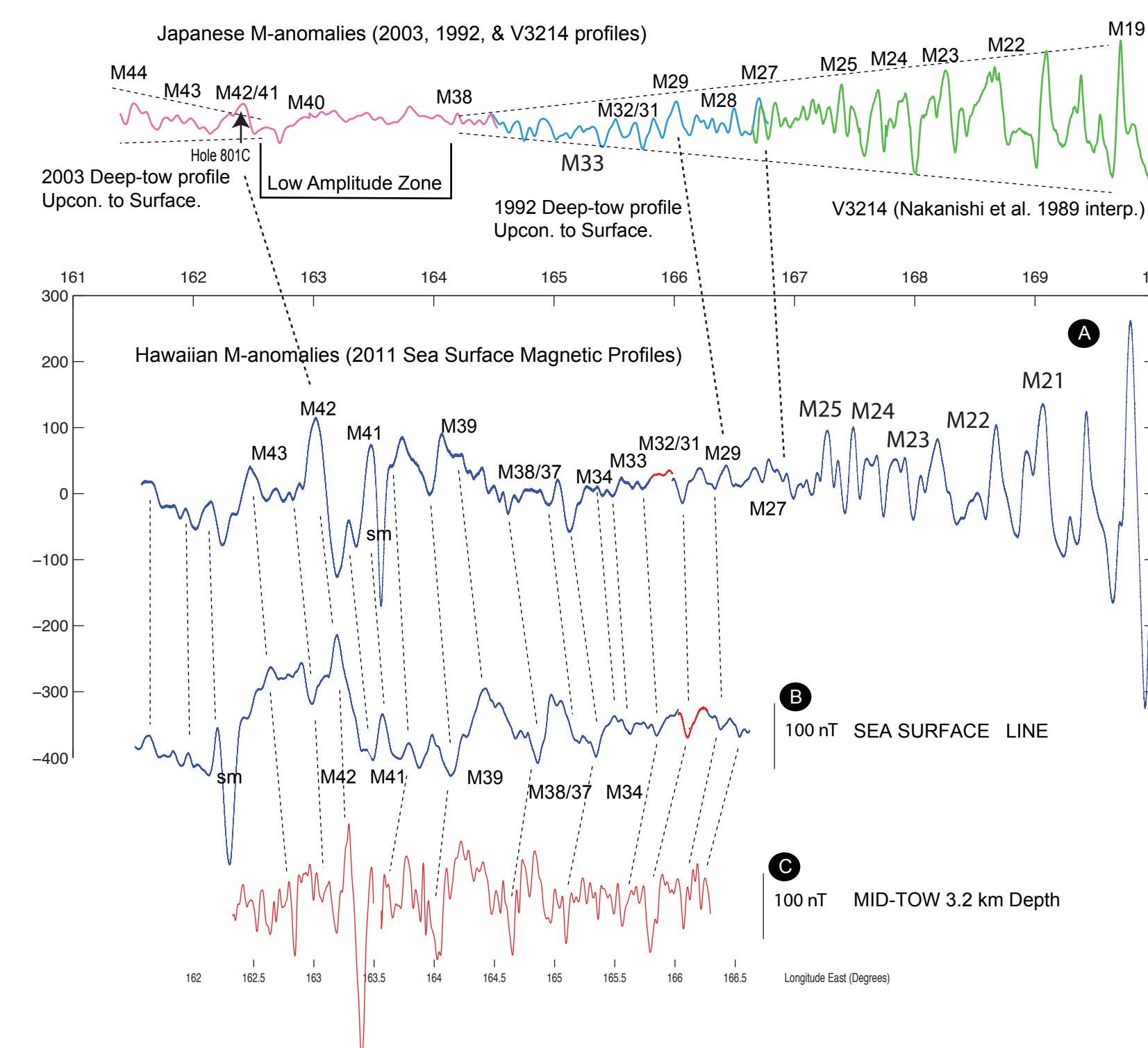


New 2011 Hawaiian Lineation Data



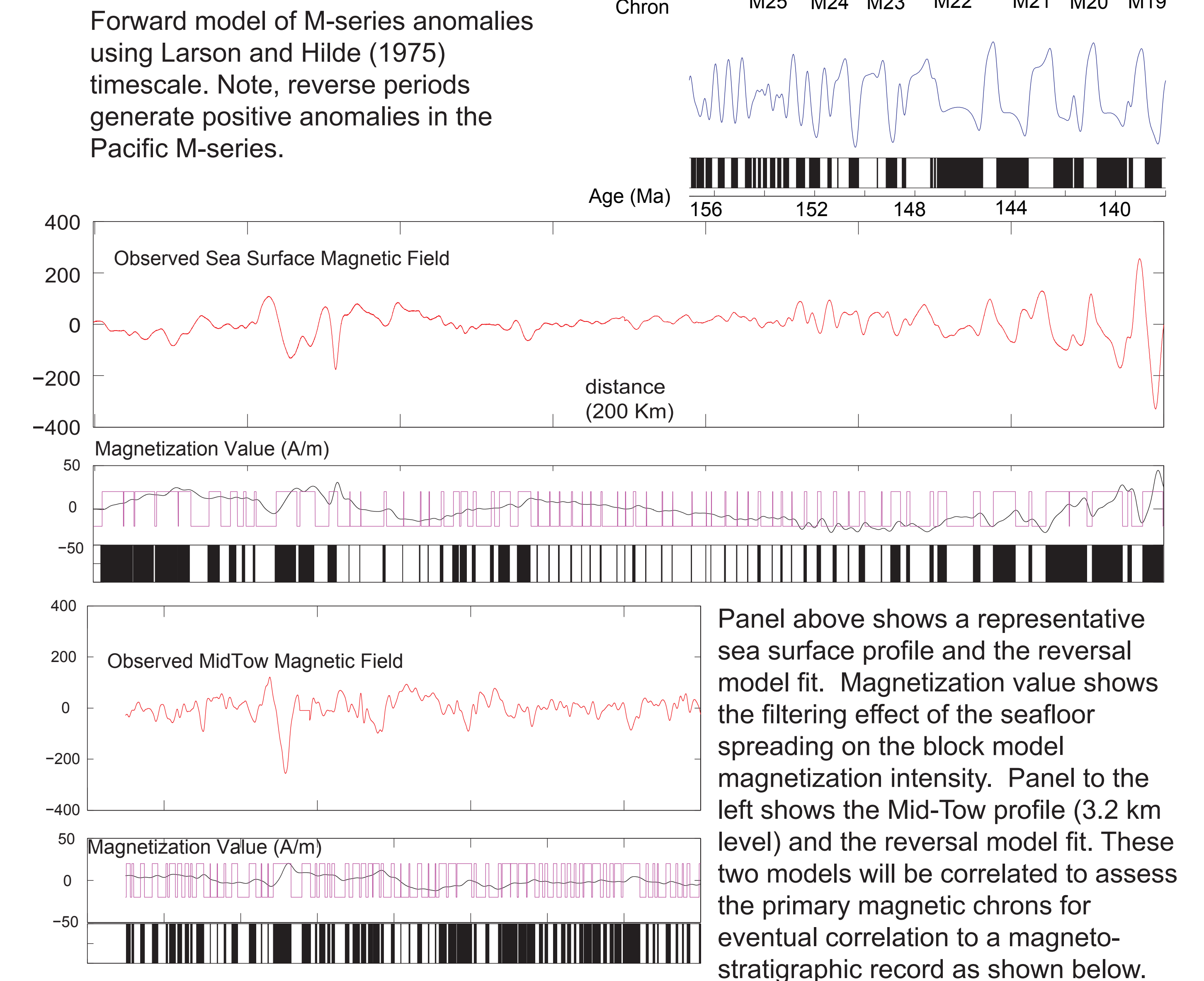
Map of 2011 Cruise (TN272) showing the survey track of sea surface magnetic profiles, the deep-towed (TowCam) magnetic profile and two short tracks of the AUV Sentry near bottom magnetic profiles.

New 2011 Hawaiian Magnetic Data



High quality seasurface marine magnetic anomaly data (blue lines) from the Hawaiian lineations along with a composite of the deep-towed TowCam magnetic profile (red line) show changes in anomaly shape and amplitude that are similar in to the Japanese lineations (top composite profile), suggesting that the anomalies record globally coherent geomagnetic field behavior for the Jurassic. The strong similarity of anomaly patterns between the Japanese and Hawaiian sequences from M19 to M38 supports the remarkably dynamic geomagnetic field behavior of fast reversals and changing intensity, confirming a proposed record of the GPTS sequence for M29 to M38. While the LAZ in the Hawaiian sequence is not as clear as in the Japanese lineations.

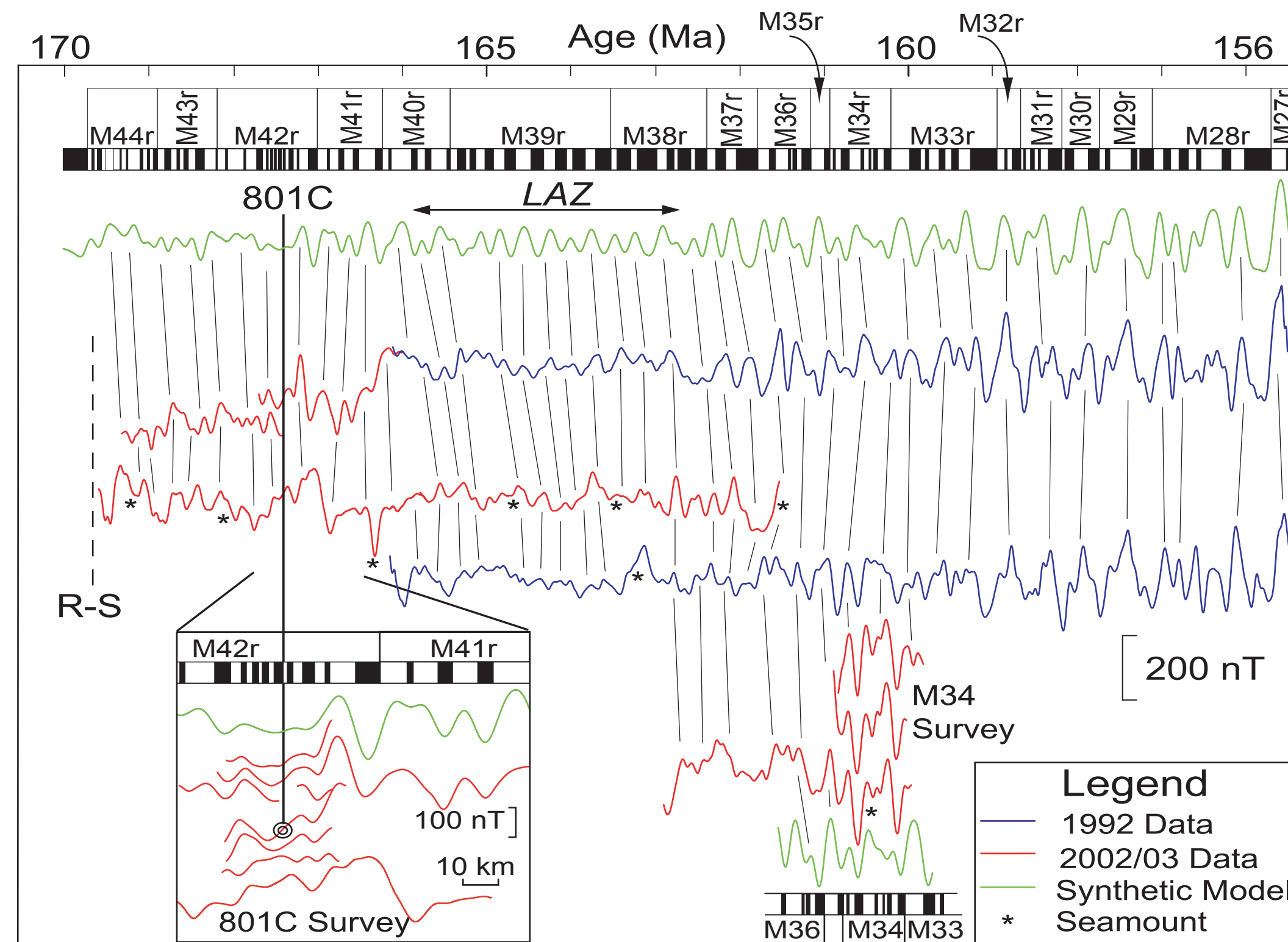
Preliminary Timescale Modeling - Hawaiian Lineation Data



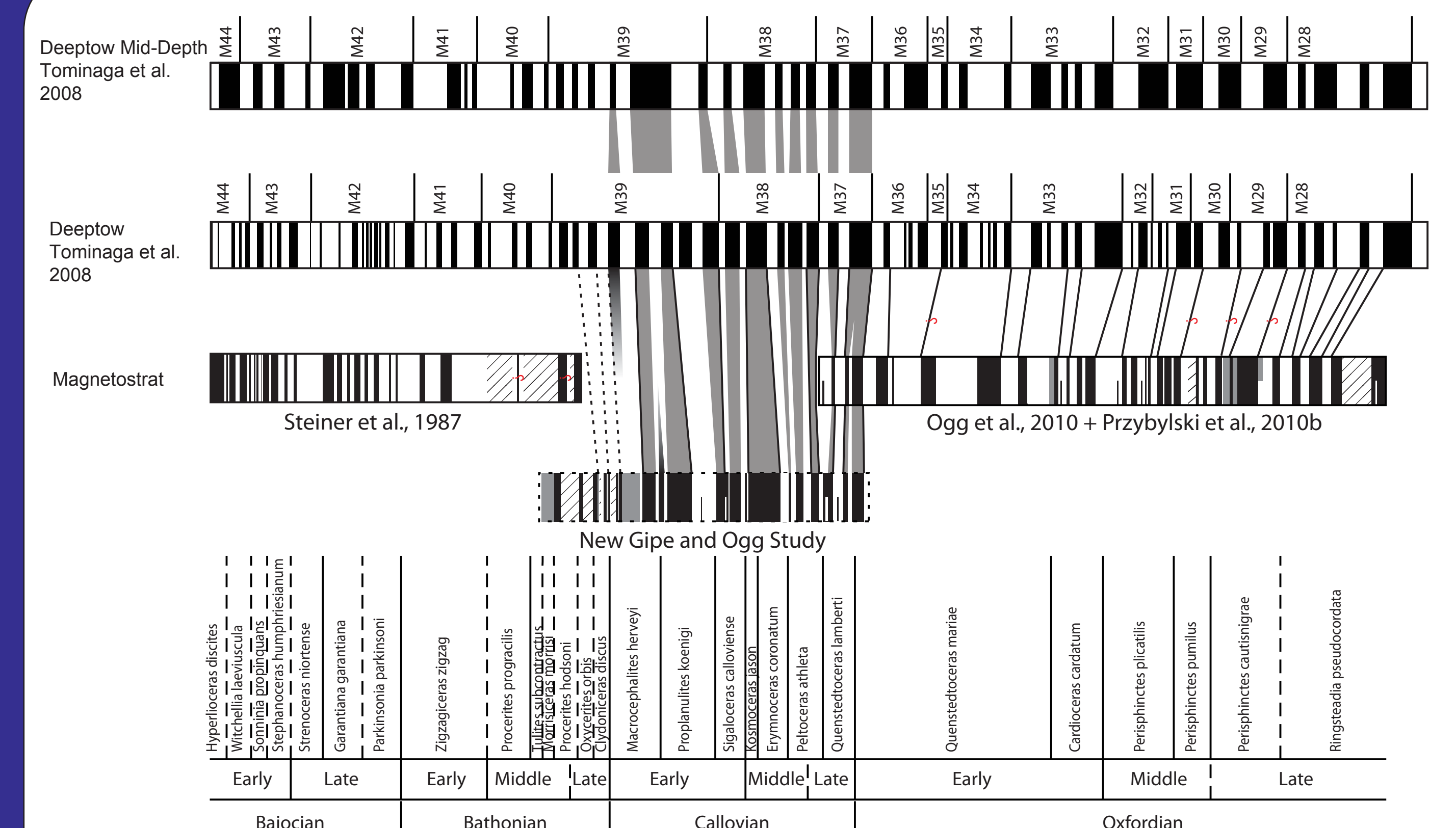
Panel above shows a representative sea surface profile and the reversal model fit. Magnetization value shows the filtering effect of the seafloor spreading on the block model magnetization intensity. Panel to the left shows the Mid-Tow profile (3.2 km level) and the reversal model fit. These two models will be correlated to assess the primary magnetic chrons for eventual correlation to a magnetostratigraphic record as shown below.

Previous Work on Japanese Lineations

The Japanese JQZ magnetic anomaly sequence was extensively investigated by an aeromagnetic and two deep-tow magnetometer surveys in 1992 and 2003, revealing (i) the presence of lineated anomalies older than M29; (ii) a GPTS record extending from M29 to M44 with a tie to ODP Hole 801C and (iii) remarkably fast reversals that decrease in intensity back in time until M38. Prior to M38 there is a low amplitude zone (LAZ) in anomalies lasting until M42, when both anomaly amplitude and a lineated character reappears around Hole 801C.



After Tivey et al., 2006, GPTS: Tominaga et al., 2008



The latest M37-M38 magnetostratigraphy (Rachel Gipe and James Ogg, Purdue Univ.)

SUMMARY

New 2011 sea surface magnetic data and a Mid-Tow magnetic profile of the Jurassic Hawaiian lineations are modelled and correlated with the magnetic sequence measured in the Japanese lineations. Preliminary modeling indicates that we have frequent and rapid reversals and a decrease in amplitude of anomalies from M29 through to M39. A low amplitude zone (LAZ) in the Japanese lineations does not appear to have the same appearance in the Hawaiian sequence. We do see a resumption of strong anomaly amplitude in the M42 to M44 sequence time period. Further modeling of the reversal sequences is underway and will help refine a revised version of the Jurassic Geomagnetic Polarity Time Scale.

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